FIG. 1

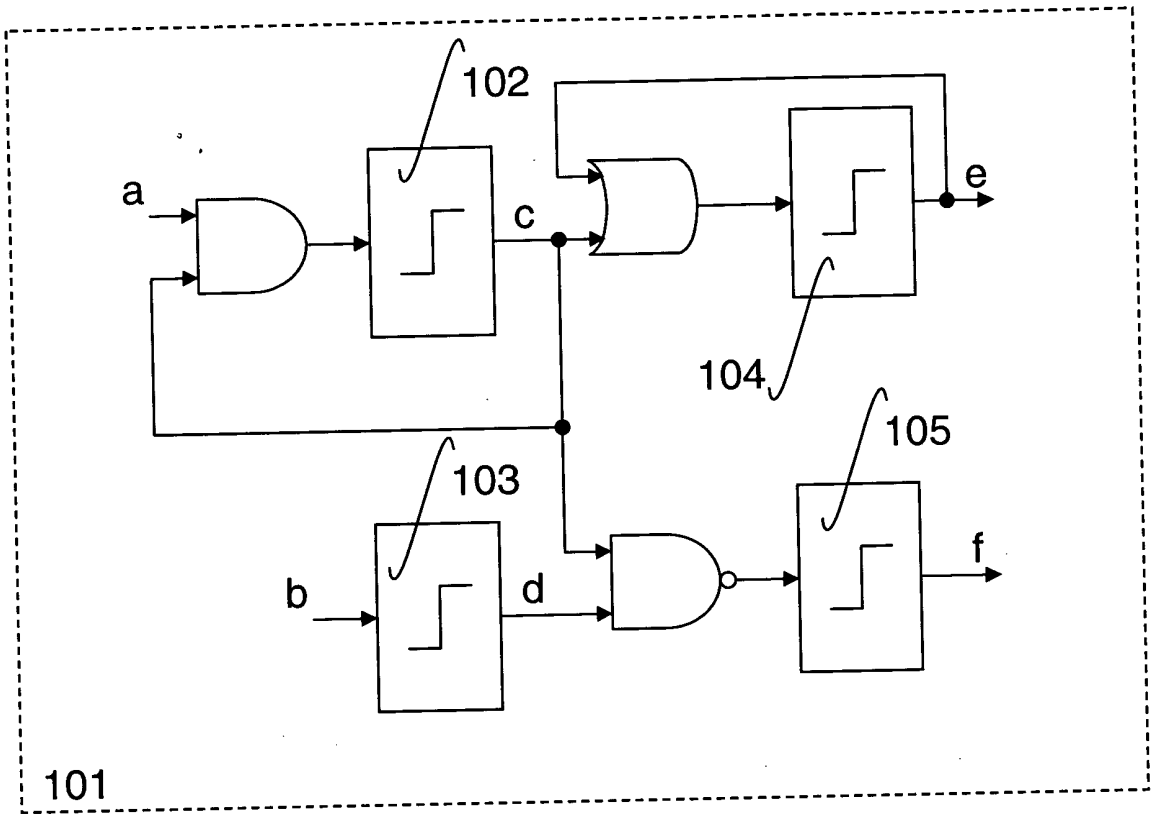


FIG. 2a

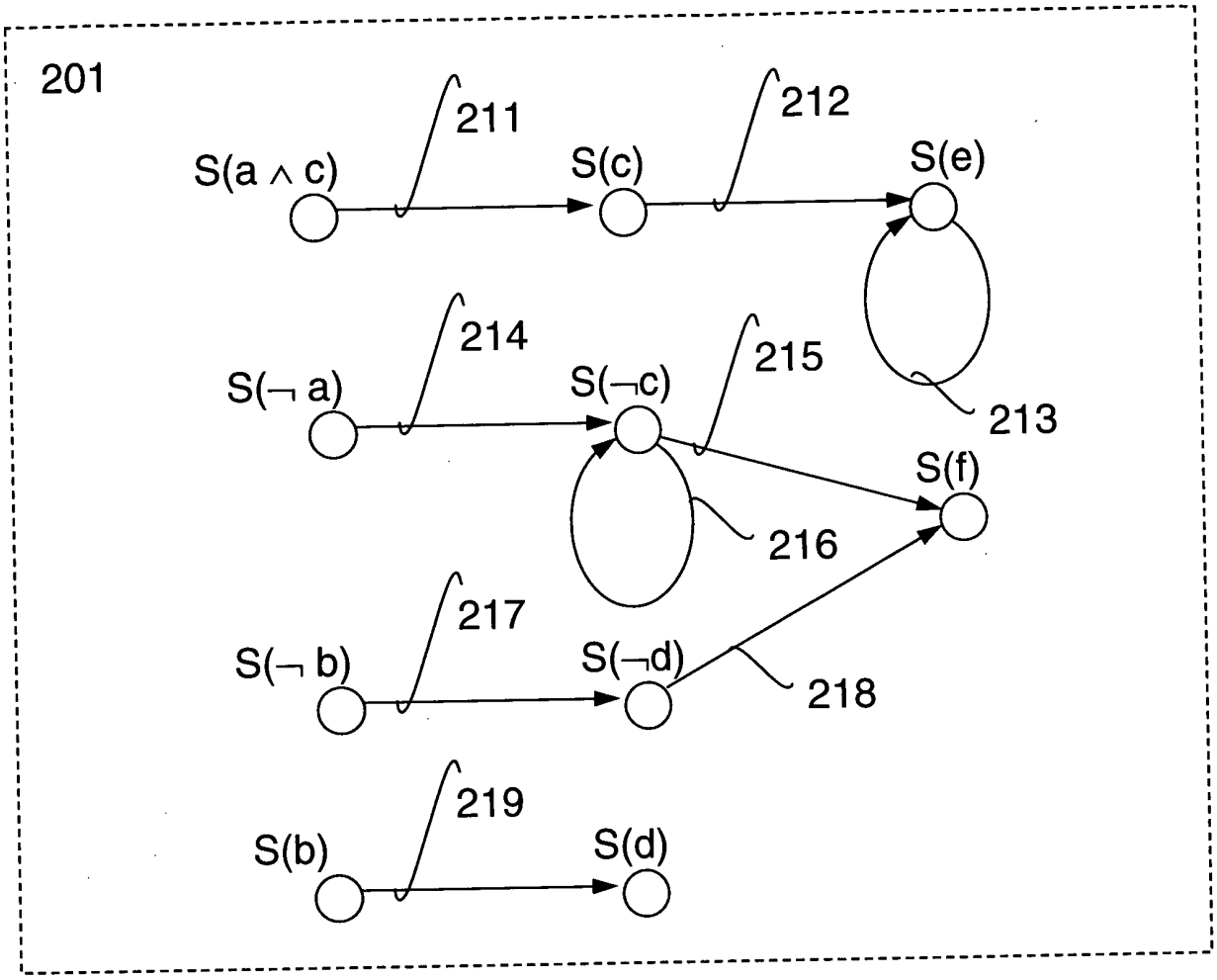

201
211
212
S(a ∧ c)
S(c)
S(e)
214
215
S(¬ a)
S(¬c)
213
S(f)
216
217
S(¬ b)
S(¬d)
218
219
S(b)
S(d)

FIG. 2b

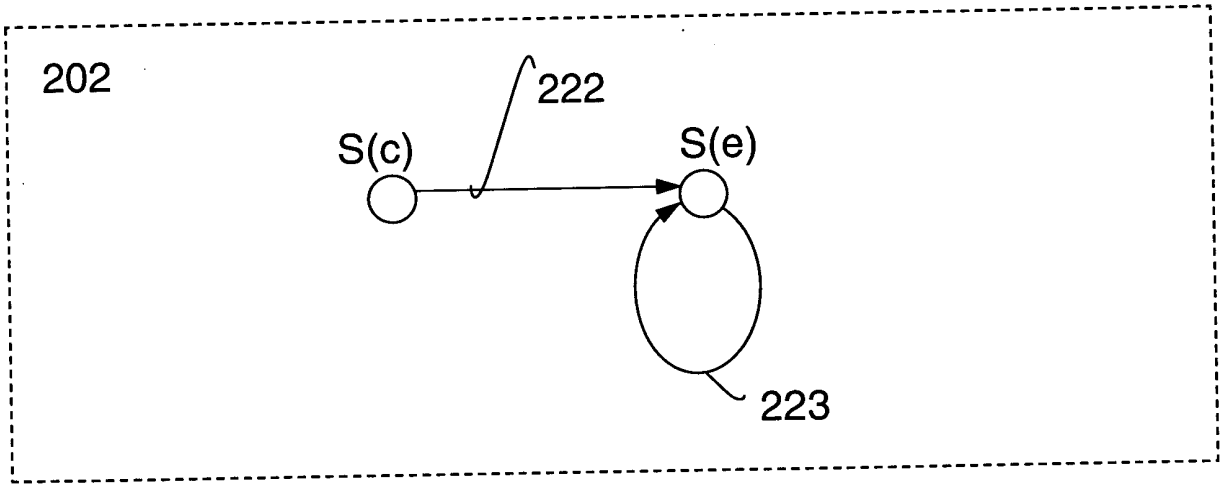

202
222
S(c)
S(e)
223

FIG. 3a

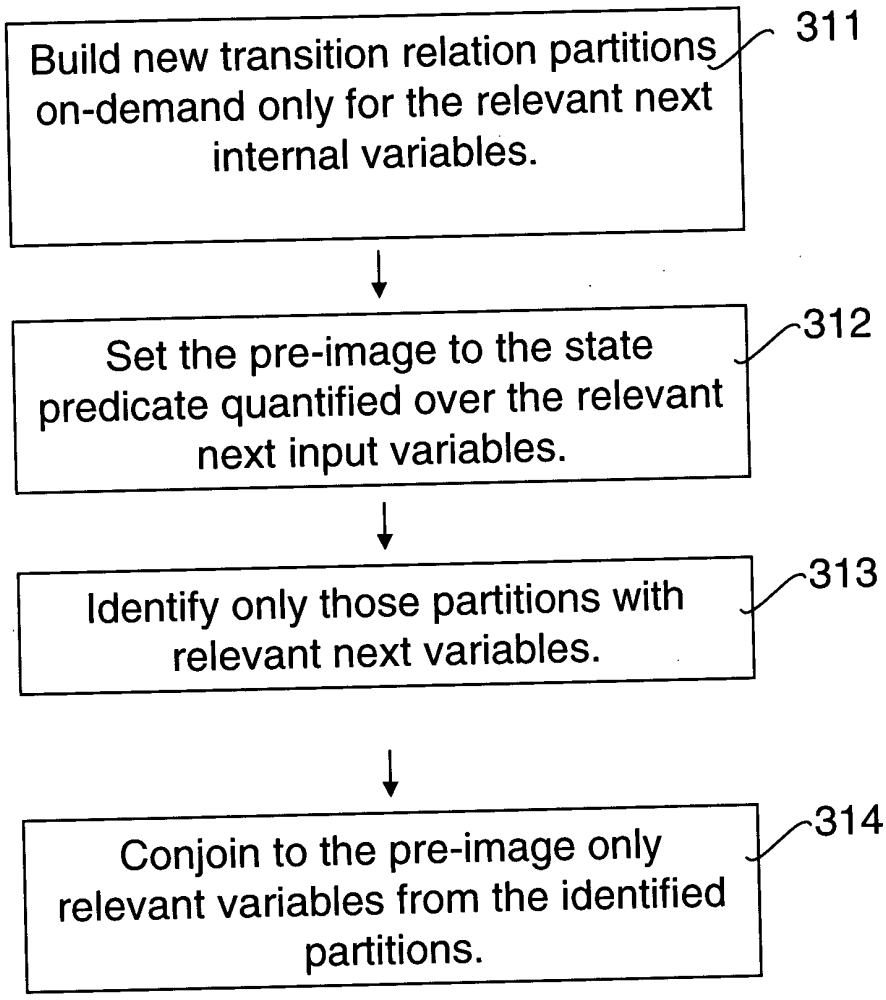

Build new transition relation partitions on-demand only for the relevant next internal variables.
311
Set the pre-image to the state predicate quantified over the relevant next input variables.
312
Identify only those partitions with relevant next variables.
313
Conjoin to the pre-image only relevant variables from the identified partitions.
314

FIG. 3b

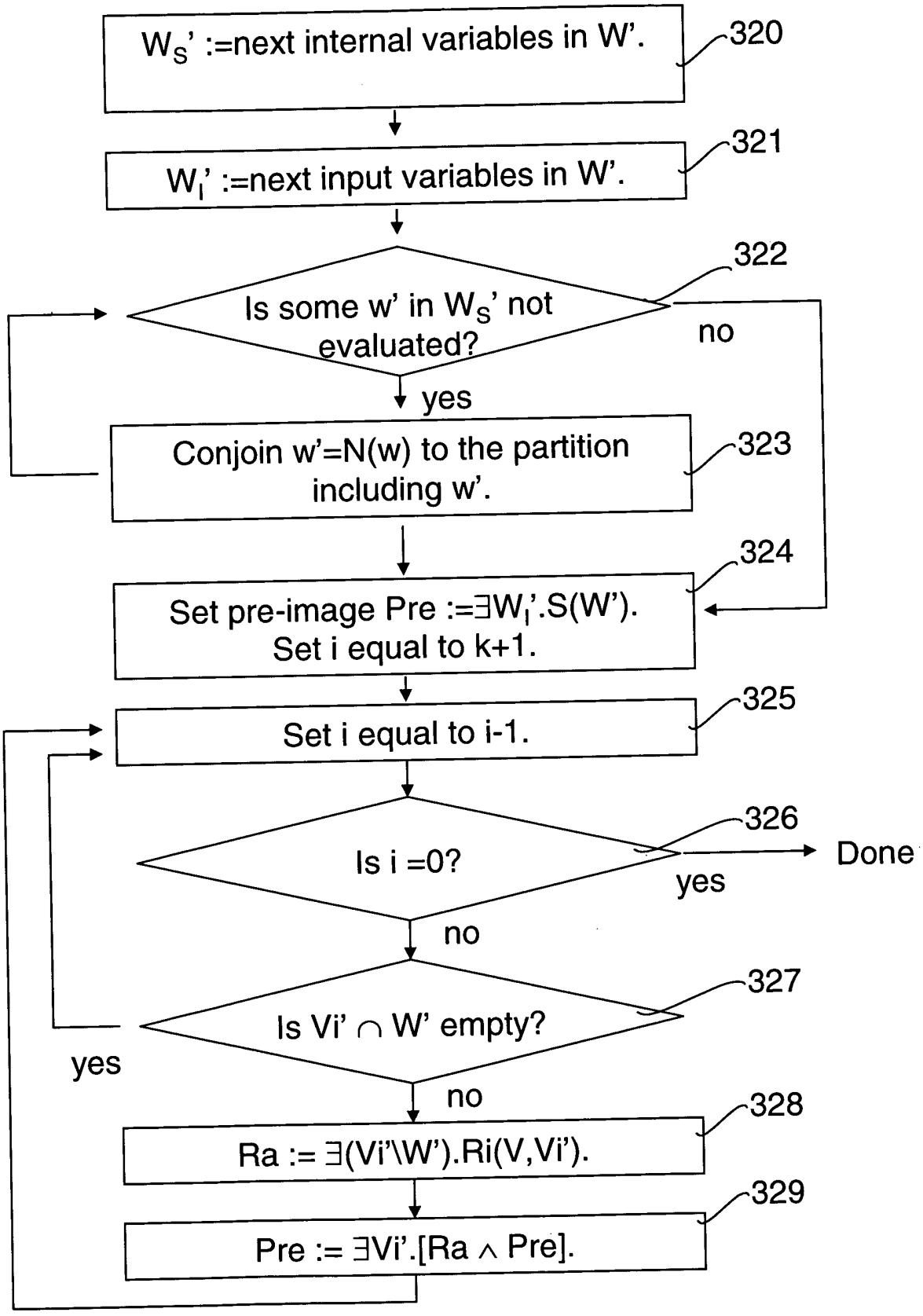

W_S' :=next internal variables in W'.
320
W_I' :=next input variables in W'.
321
Is some w' in W_S' not evaluated?
322
no
yes
Conjoin w'=N(w) to the partition including w'.
323
Set pre-image Pre :=∃W_I'.S(W').
Set i equal to k+1.
324
Set i equal to i-1.
325
Is i =0?
326
yes
Done
no
Is Vi' ∩ W' empty?
327
yes
no
Ra := ∃(Vi'\W').Ri(V,Vi').
328
Pre := ∃Vi'.[Ra ∧ Pre].
329

FIG. 4a

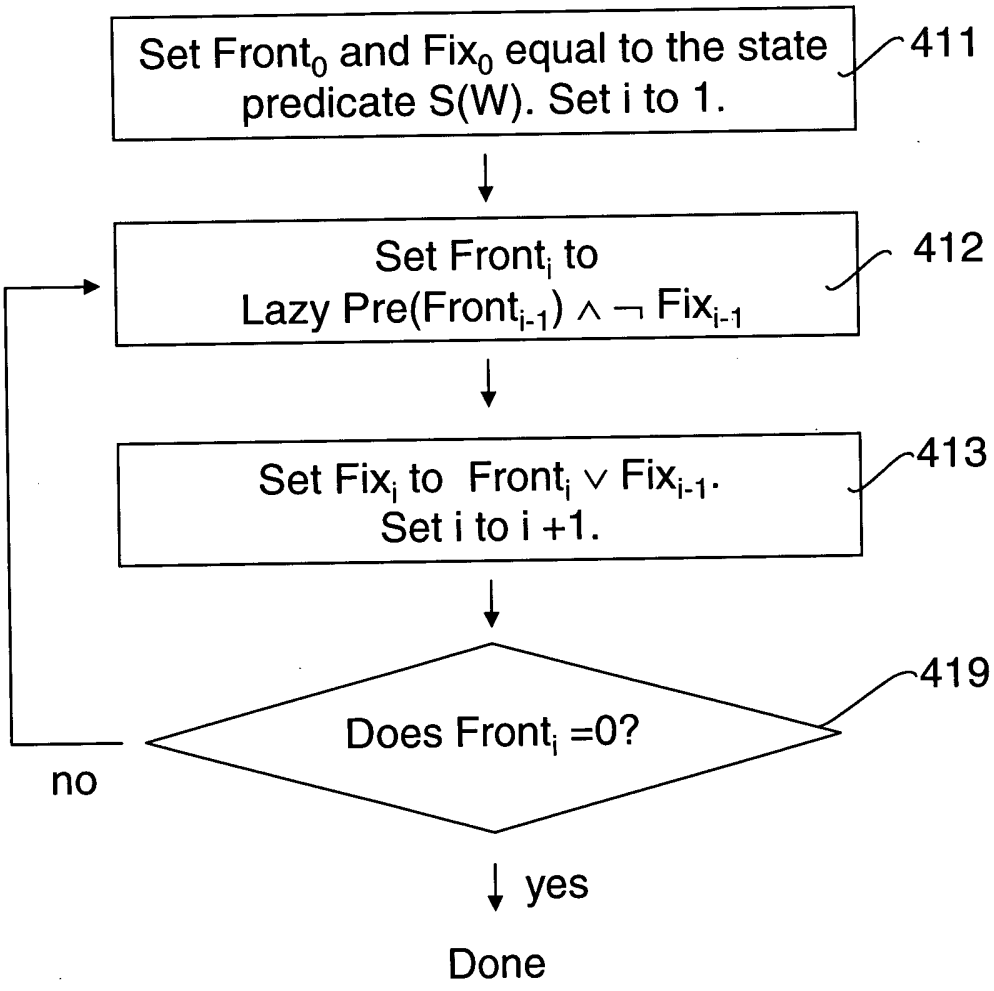

Set Front$_0$ and Fix$_0$ equal to the state predicate S(W). Set i to 1.
411
Set Front$_i$ to Lazy Pre(Front$_{i-1}$) $\wedge \neg$ Fix$_{i-1}$
412
Set Fix$_i$ to Front$_i$ $\vee$ Fix$_{i-1}$. Set i to i +1.
413
Does Front$_i$ =0?
419
no
yes
Done

FIG. 4b

# of transitions	Front	Transition Relation	Lazy Pre-image	Fixpoint
0	e	[ ]		e 420
1	c AND NOT e	[N(e)= e OR c]	e OR c	e OR c 421
2	∅	[N(e)= e OR c N(c)= c AND a]	(c AND a) AND NOT (e OR c)	e OR c 422

FIG. 5a

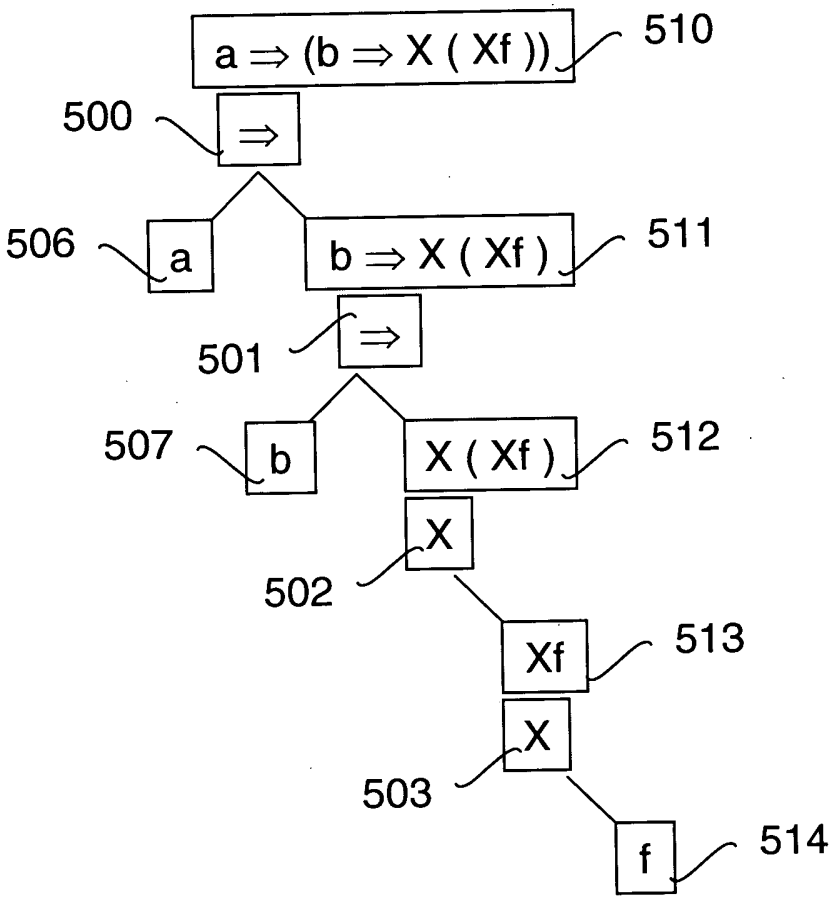

a ⇒ (b ⇒ X (Xf))
510
500
⇒
506
a
b ⇒ X (Xf)
511
501
⇒
507
b
X (Xf)
512
X
502
Xf
513
X
503
f
514

FIG. 5b

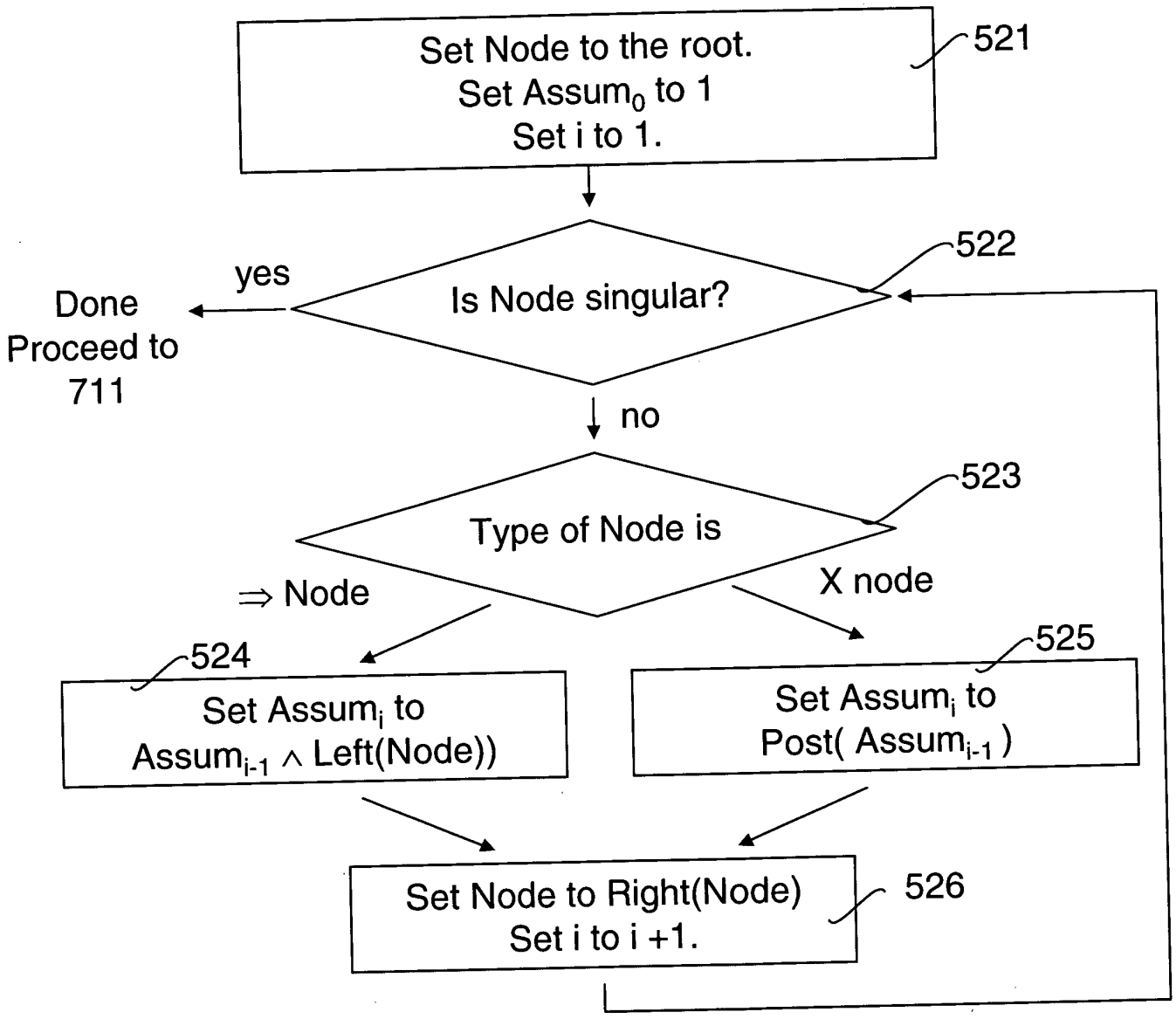

Set Node to the root.
Set Assum$_0$ to 1
Set i to 1.
521
Is Node singular?
522
yes
Done
Proceed to
711
no
Type of Node is
523
⇒ Node
X node
524
Set Assum$_i$ to
Assum$_{i-1}$ ∧ Left(Node))
525
Set Assum$_i$ to
Post(Assum$_{i-1}$)
Set Node to Right(Node)
Set i to i +1.
526

FIG. 5c

Iteration	Assumption	Sub-property
0	1 540	$a \Rightarrow (b \Rightarrow X(Xf))$ 530
1	a 541	$b \Rightarrow X(Xf)$ 531
2	$a \wedge b$ 542	$X(Xf)$ 532
3	$Post(a \wedge b)) = d$ 543	Xf 533
4	$Post(Post(a \wedge b)) = 1$ 544	f 534

FIG. 6a

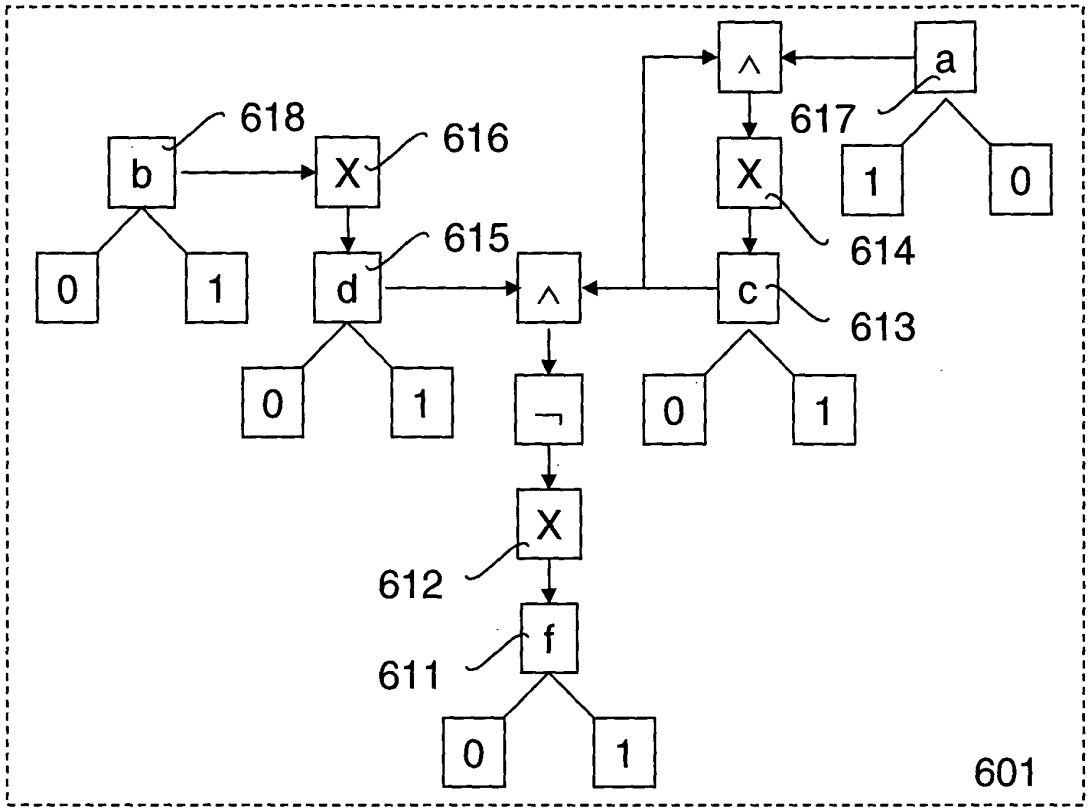

b
618
X
616
0
1
d
615
^
^
a
617
X
614
1
0
c
613
0
1
¬
0
1
X
612
f
611
0
1
601

FIG. 6b

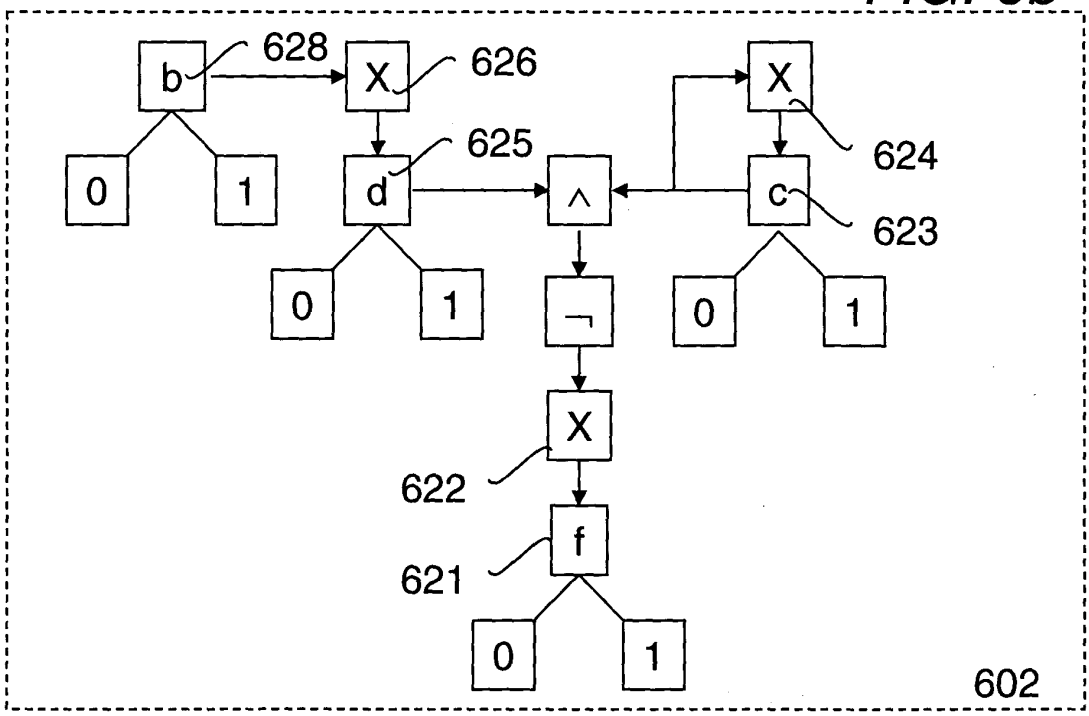

b
628
X
626
0
1
d
625
^
X
624
c
623
0
1
¬
0
1
X
622
f
621
0
1
602

FIG. 6c

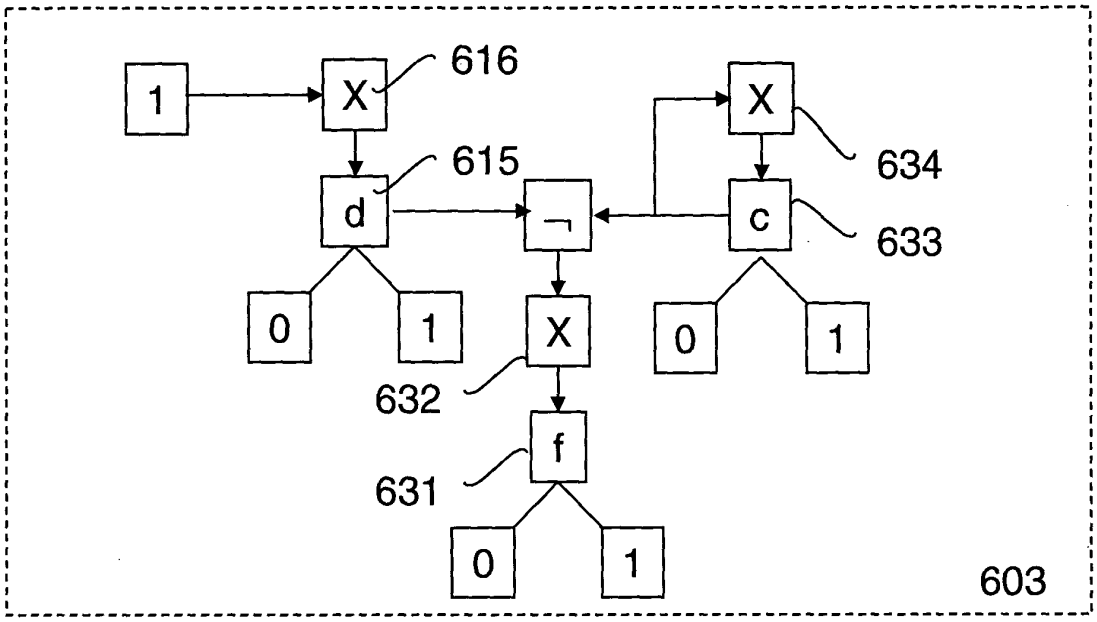

1
X
616
d
615
¬
X
634
c
633
0
1
X
632
f
631
0
1
0
1
603

FIG. 6d

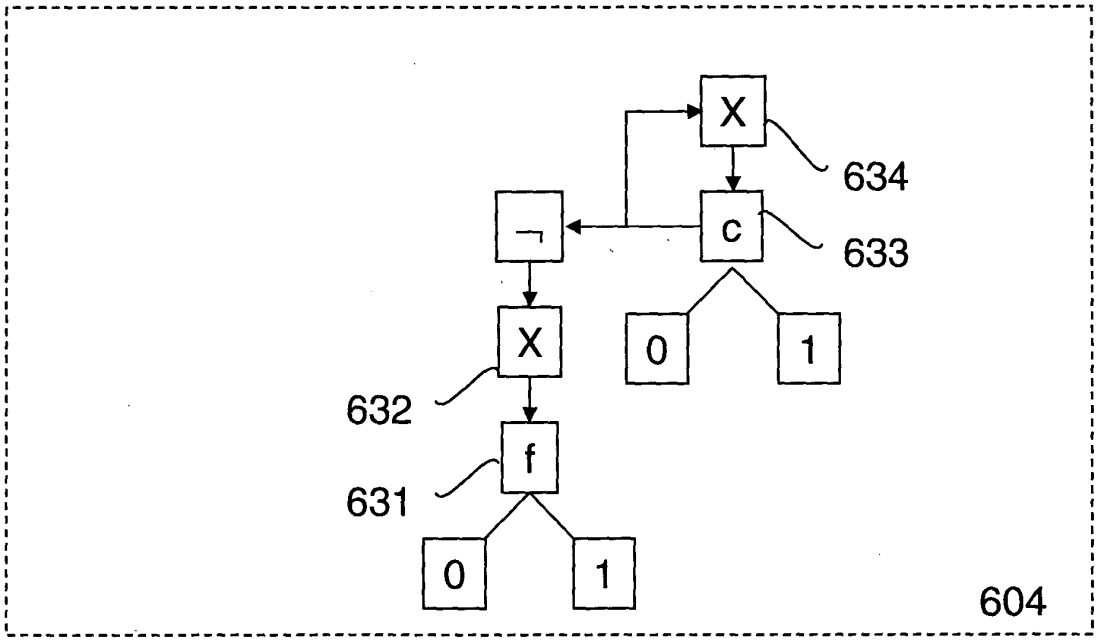

X
634
¬
c
633
X
0
1
632
f
631
0
1
604

FIG. 7a

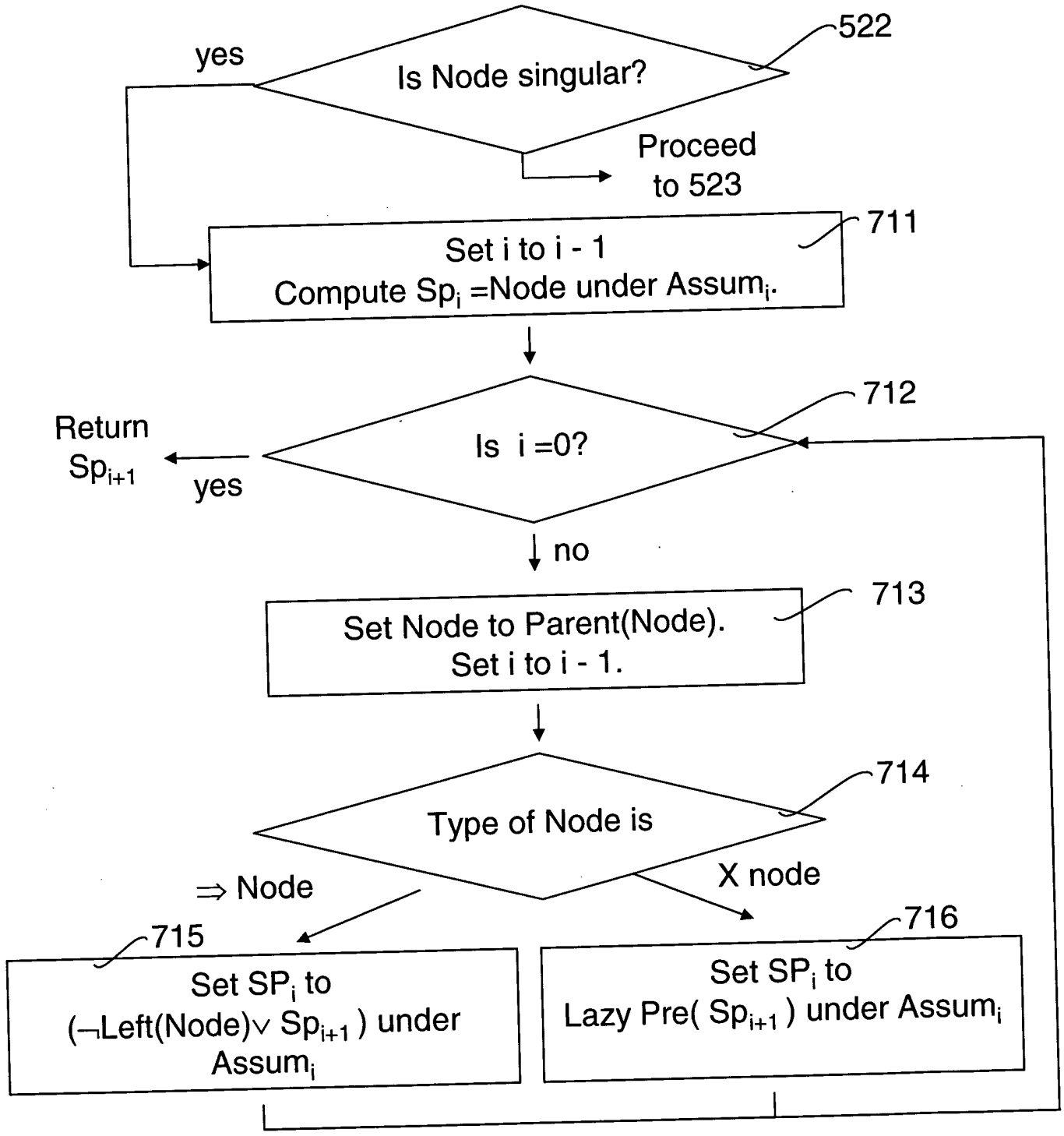
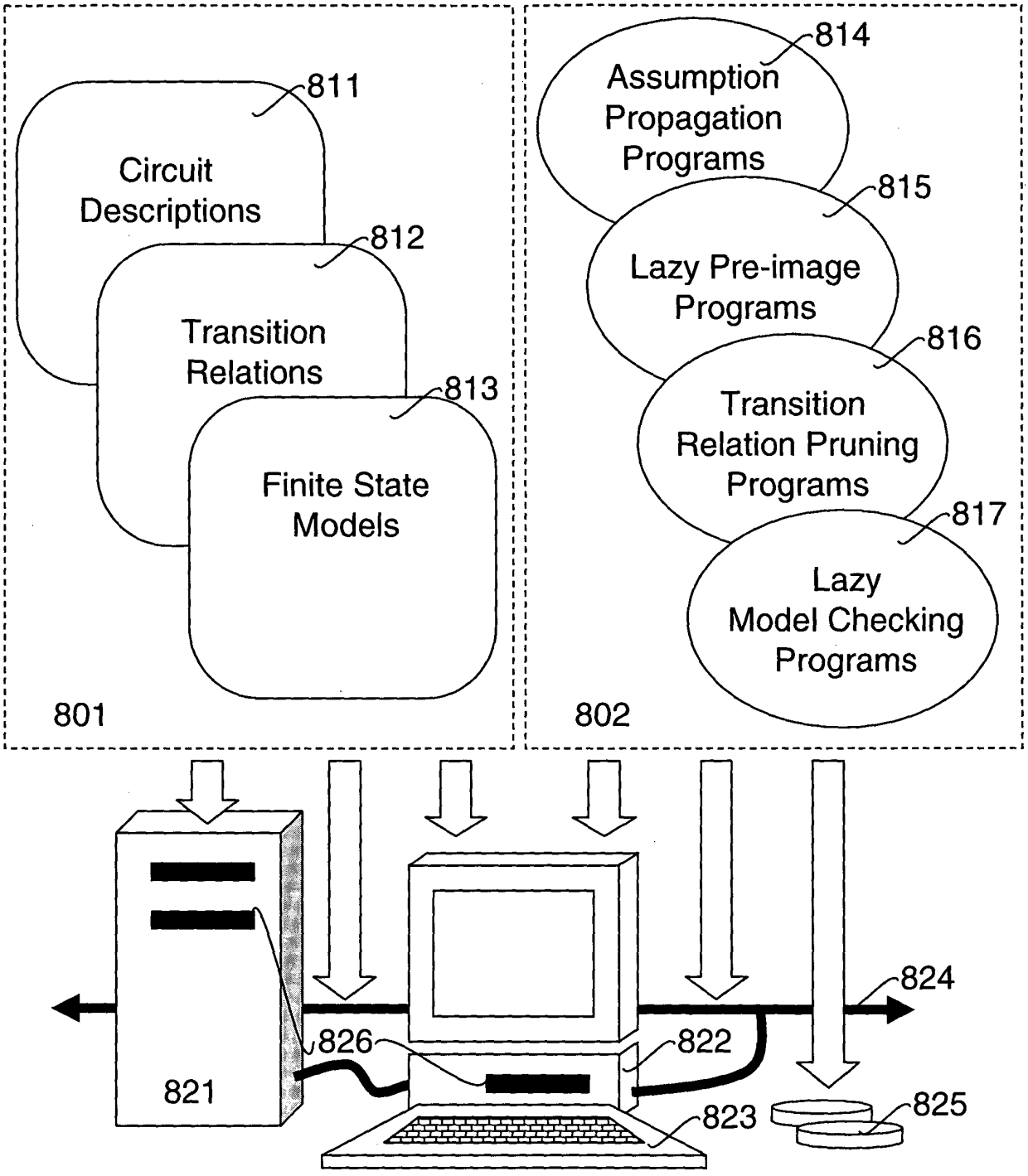

Is Node singular?
522
yes
Proceed to 523
Set i to i - 1
Compute Sp_i =Node under Assum_i.
711
Is i =0?
712
Return Sp_i+1
yes
no
Set Node to Parent(Node).
Set i to i - 1.
713
Type of Node is
714
⇒ Node
X node
715
Set SP_i to (¬Left(Node)∨ Sp_i+1) under Assum_i
716
Set SP_i to Lazy Pre(Sp_i+1) under Assum_i

FIG. 7b

# of iteration	Assum	Reduced Transition Relation	Sub-property	State Predicate
4	1	[ ]	f	f 724
3	d	[N(f)= NOT c]	Xf	NOT c 723
2	a AND b	[N(c)= c]	X(Xf)	NOT c 722
1	a		$b \Rightarrow X(Xf)$	NOT b OR NOT c 721
0	1		$a \Rightarrow (b \Rightarrow X(Xf))$	NOT a OR NOT b OR NOT c 720

FIG. 8


811
Circuit Descriptions
812
Transition Relations
813
Finite State Models
801
814
Assumption Propagation Programs
815
Lazy Pre-image Programs
816
Transition Relation Pruning Programs
817
Lazy Model Checking Programs
802
824
826
822
821
823
825